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Analysis Development Costs And Benefits Facility Processing Garbage (Manado City Case Study)

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Abstract: Manado City is one of the second largest cities on the northern island of Sulawesi with a population growth rate that continues to increase from year to year, in 2013 the population reached 419,596 people, and in 2020 the population reached 451.616 people, in 2020 the waste produced was 121.504,81 tons / year with a population of 451,616, and in 2021 the waste produced is 124,059.81 Tons / Year with a population of 453.182, the amount of waste that can be managed by the Manado City Government is 107.408 Tons / Year (86.58%), for details of waste managed is 17.618 Tons / Year (14.20%) waste processed at the Sumompo Landfill is 89.790 Tons / Year (72.38%), of the amount of waste produced is not supported by adequate waste processing facilities, in Manado City waste processing facilities such as TPS 3R = 2 units, waste banks = 3 units, compost houses = 0 units, Incinerators = 4 units. Based on this background, waste processing facilities are examined in order to analyze the costs and benefits of developing waste treatment facilities in Manado City. using three variables to obtain the highest Net Value and BCR values, for Net Value and BCR values from the first alternative Net Value of Rp. 9.657.293.149,41 with a BCR value of 6.90, for the second alternative Net Value -Rp 480.866.953,75,- with a Benefit Cost Ratio value of "0.67", and for the third alternative Net Value of Rp. 235.498.801,75 with a Benefit Cost Ratio value of "1.30", The first alternative is alternative which is recommended to be applied because the BCR value > 1. From these results, it is expected to provide information to waste management authorities in Manado City in choosing alternative 3R TPS based on Net Value, Benefit Cost Ratio and Analyzes Sensitivity.

Keywords: Net Value, Bcr, Analyzes Sensitivity

1. Introduction

Place management rubbish *Reduce, Reuse, Recycle* or usually called TPS 3R is place For manage rubbish Good rubbish organic , plastic and non- organic in a way structured , so results from processed rubbish Can give mark sell , besides that can also be done open field work For inhabitant around. The moment potency rubbish The solid produced in Manado City in 2019 was 303,544 tons / year , with amount resident amounting to 433,635 people, in 2020 the waste produced amounting to 121,504.81 tons/ year with amount population 451,616 people , and in 2021 the waste produced amounting to 124,059.81 tons/ year with amount population 453,182 people , total The waste that can be managed by the Manado City government is 107,408 tons/ year (86.58%), for details managed waste namely 17,618 tons/ year (14.20%) of waste processed at Sumompo TPA amounting to 89,790 tons/ year (72.38%) for amount rubbish will Keep going increase in accordance rate growth residents in Manado City.

In election facility development of TPS 3R in general use CBA (Cost Benefit Analysis) method for look for mark *Net Value* and BCR, however in method This No can show impact if happen change factor like up or down change price material burn oil nor change wages employee. Sensitivity analysis used For repair method implementation project , design of the project that will be carried out For know impact changes that occur during implementation A influencing projects BCR and *Net Value* values , yes various type factor affecting analysis sensitivity is one of them rising and falling factors price material burn oil and salaries employees, with did it analysis sensitivity This can make alternative second if alternative main experience change factor material burn oil or wages employee.

TPS 3R in Manado City which is operational moment This is in the District Malalayang at TPS 3R only can manage rubbish amounting to 9.13 tons/ year, for TPS 3R in Paal Dua District already stop operate caused No exists equipment and manpower work and lack thereof support from government local . Another

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factor is the lack of TPS 3R units is one of them factor subtraction or elimination There is less waste in Manado City walk with maximum. Based on background behind this, development facility processing rubbish chosen For researched in frame analyze benefits and costs based on mark *Net Value* and BCR, as well analysis sensitivity For take the best decision in the selection process development based on BCR value and *Net Value*. Then from analysis This can provide advice and information to government local about benefits and costs in the development process facility processing TPS 3R waste.

2. Research Methods

Primary data required is information about wide building and area room processing (length, width, height) of District 3R TPS Malalayang and Paal Dua District. Secondary data used in study This is the volume of waste from 2019-2021 , waste volume district per day , amount waste that can be managed per year in the city Manado , total waste that can be managed by TPS 3R per year , amount facility support , from this data can give description about condition facility processing the waste that is reviewed is obtained from the Manado City Environmental Service and District TPS 3R Malalayang and Paal Districts, two Manado Cities.

Analyze data with method *Cost Benefit Analysis* (CBA) for get mark *Net Value* and value *Benefit Cost Ratio* (BCR) of condition existing until with three development , for three development will be explained below _ This :

- Scenario First form development of District 3R TPS Malalayang with optimization capacity production machine enumerator compost addition machine enumerator plastic and machines sieve compost, addition TPS 3R area so Can optimizing incoming rubbish from two sub-districts that is Sario District and District Malalayang.
- Scenario second Scenario the second, namely development development one new 3R TPS unit in the District Mapanget Already including equipment and facilities along with the operation of TPS 3R in the Existing District Malalayang.
- Scenario to three development TPS 3R facilities in Paal Dua District which are not operate with addition tool tool new and facilities new along with the operation of TPS 3R in the Existing District Malalayang.

In the analysis process with use CBA method exists component benefits and components cost , components cost consists from :

- Cost direct.
- Cost No direct .

Component benefit consists from :

- Immediate benefits .
- Benefits no direct .

In detail the components benefits and costs of research This will explained in the table below This :

Table 1. Analysis Costs And Benefits

Component Type	Component	Items
Component Cost :		
Cost Direct	Cost investment :	
	Cost rent or buy land	C1
	Cost Procurement Equipment	C2
	Cost Operational :	
	Wages Worker	C3
	Electricity and water costs	C4
	Cost material burn	C5
	Cost maintenance machines and buildings	C6
Indirect Costs _	Emission from activity transportation rubbish	C7
	Emission results processing rubbish	C8
Component benefit :		
Immediate benefits	Sales results product cycle repeat rubbish	B1
	subtraction fuel consumption (transporter rubbish)	B2

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	Subtraction CO_2 emissions from transportation rubbish	B3
Benefits no direct	Reduction of $CH_{4\ gas}$ in landfill	B4
	Subtraction cost impact health	B5

Source (M. Chaerul, 2019)

Analysis component costs and benefits done with add up from each component For get *net cost* and *net benefit* , for equality *net costs* and *net benefits* as following :

- *Net cost* = C1+C2+C3+C4+C5+C6+C7+C8.
- *Net Benefit* = B1+B2+B3+B4+B5.

After know results from *Net cost* and *Net benefit* from scenario development , then next with count *Net Value* and BCR of scenario development with equality :

- *Net Value = Net Benefit – Net Cost*
- BCR = $\frac{\text{Net benefit}}{\text{Net Cost}}$

furthermore done analysis sensitivity to variables material burn oil and salaries employee with a change limit of -20% until it rises to 20% of three scenario development , in order to obtain scenario development best .

Research sites taken at TPS 3R Subdistrict Malalayang and Paal Dua District , Manado City. Figure 1 and Figure 2, show map location study .

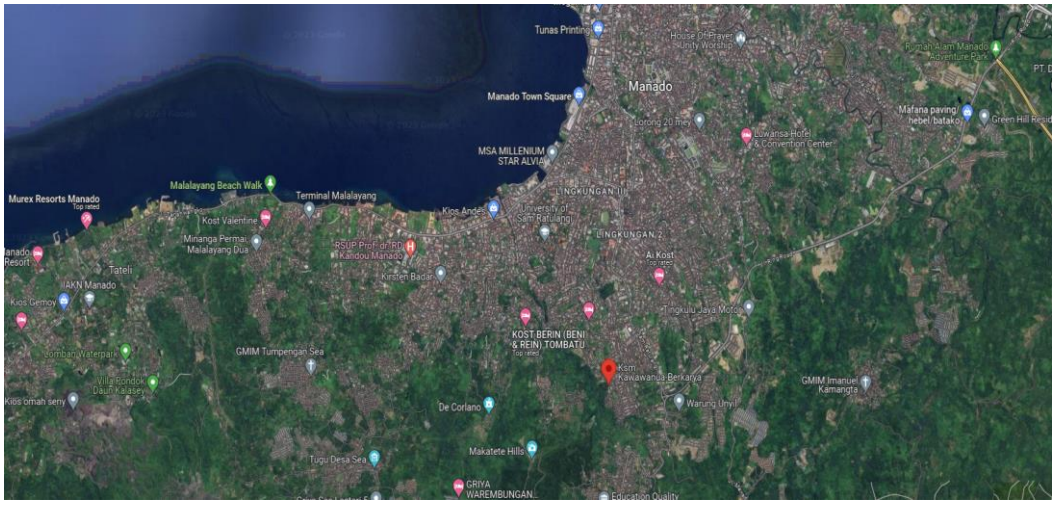

Figure 1. Location of District 3R TPS Malalayang

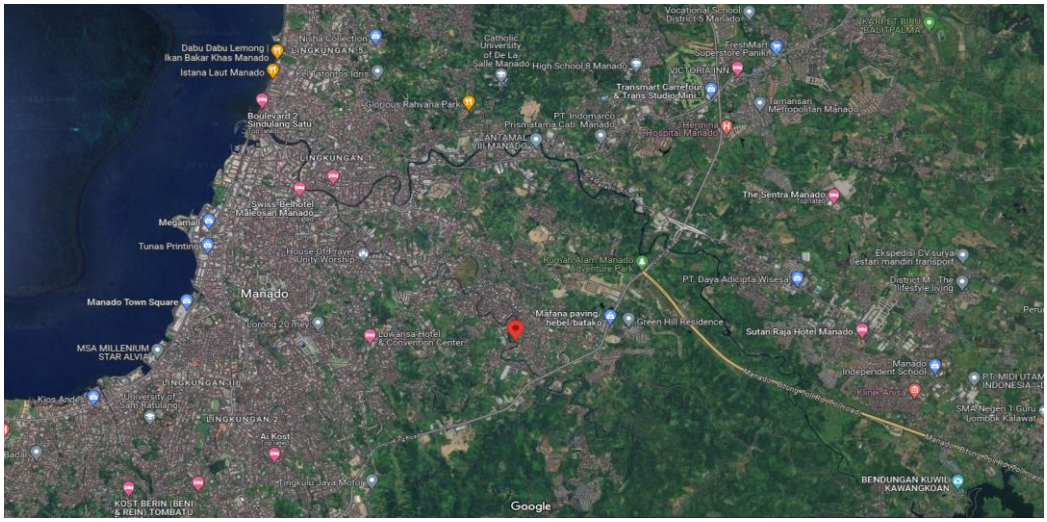

Figure 2. Location of TPS 3R Paal Dua District

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3. Results And Discussion

3.1. Analysis Rubbish

Based on three scenario developments discussed in the research This chosen four Districts in Manado City, namely Subdistrict Malalayang , Sario District , Paal Dua District and District Mapanget , for calculation rubbish follow standard from SNI (Indonesian National Standard), for emergence rubbish city small 2.75 liters/person/ day or The same with 0.7 kg/person/ day , will explained in the table under This .

Table 2. Generation Rubbish Subdistrict Malalayang

Subdistrict Malalayang				
No	Year	Amount Resident	Unit Manado City Waste Manado City LH Department Standards (Kg/Day/Person)	Total Waste (Kg/Day)
1	2017	58,146.00	0.7	40,702.20
2	2018	57,879.00	0.7	40,515.30
3	2019	59,885.00	0.7	41,919.50
4	2020	61,891.00	0.7	43,323.70
5	2021	62,040.00	0.7	43,428.00

(Source : Analysis Results)

Table 3. Generation Rubbish Sario District

Sario District				
No	Year	Amount Resident	Unit Manado City waste , Manado City LH Service Standards (Kg/Day/Person)	Total Waste kg/ day
1	2017	24,278.00	0.7	16,994.
2	2018	24,391.00	0.7	17,073.
3	2019	23,065.50	0.7	16,145.
4	2020	21,740.00	0.7	15,218.
5	2021	21,737.00	0.7	15,215.

(Source : Analysis Results)

Table 4. Generation Rubbish Paal Dua District

Paal 2 District				
No	Year	Amount Resident	Unit Manado City waste , Manado City LH Service Standards (Kg/Day/Person)	Total Waste (Kg/Day)
1	2017	42,496.00	0.7	29,747.20
2	2018	43,750.00	0.7	30,625.00
3	2019	43,884.00	0.7	30,718.45
4	2020	44,015.00	0.7	30,810.50
5	2021	44,097.00	0.7	30,867.90

(Source : Analysis Results)

Table 5. Generation Rubbish Sario District

Sario District

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No	Year	Amount Resident	Unit Manado City Waste Manado City LH Department Standards (Kg/Day/Person)	Total Waste (Kg/Day)
1	2017	24,278.00	0.7	16,994.60
2	2018	24,391.00	0.7	17,073.70
3	2019	23,065.50	0.7	16,145.85
4	2020	21,740.00	0.7	15,218.00
5	2021	21,737.00	0.7	15,215.90

(Source : Analysis Results)

3.2. Cost Benefit Analysis (CBA) Results

Result of analysis condition existing and three scenario development obtained mark *Net Cost, Net Benefit* , *Net Value* and BCR will be explained in Table 6. In research This For development third No There is cost rent or buy land (C1) is caused Already available from owner land .

Table 6. *Cost Benefit Analysis* Three Development

Cost Benefit Analysis Three Development					
Type	Component	Condition Existing District Malalayang	Development of TPS 3R Kec Malalayang	Development of New 3R TPS Kec Mapanget + TPS 3R Exiting Condition	Development of 3R TPS Paal Dua District + 3R TPS Conditions Existing
Cost		Nominal	Nominal	Nominal	Nominal
Direct	C1	Rp -	IDR 10,301,745	IDR 652,050,000	Rp -
	C2	Rp -	IDR 204,000,000	IDR 191,500,000	IDR 191,500,000
	C3	IDR 83,640,000	IDR 1,087,320,000	IDR 376,380,000	IDR 376,380,000
	C4	IDR 6,001,800	IDR 6,001,806	IDR 12,003,606	IDR 12,003,606
	C5	IDR 63,830,400	IDR 222,657,600	IDR 140,140,800	IDR 140,140,800
	C6	IDR 13,557,216	IDR 56,120,472	IDR 29,904,520	IDR 29,904,520
	Sub-Total	IDR 167,029,416	IDR 1,586,401,623	IDR 1,401,978,926	IDR 749,928,926
Indirect _	C7	IDR 21,066,023	IDR 31,599,034	IDR 42,132,046	IDR 42,132,046
	C8	Rp. 62,030	IDR 17,986,715	IDR 2,648,140	IDR 2,648,140
	Sub-Total	IDR 21,128,053	IDR 49,585,749	IDR 44,780,187	IDR 44,780,187
Net Cost		**IDR 188,157,469**	**IDR 1,635,987,373**	**IDR 1,446,759,113**	**IDR 794,709,113**
Benefit					
Direct	B1	IDR 36,103,608	IDR 10,862,256,999	IDR 762,955,608	IDR 762,955,608
	B2	IDR 34,080,000	IDR 338,125,200	IDR 38,716,800	IDR 120,096,000
	B3	IDR 15,951,897	IDR 12,127,899	IDR 26,700,648	IDR 24,743,494

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	Sub-Total	IDR 86,135,505	IDR 11,212,510,099	IDR 828,373,056	IDR 907,795,102
Indirect _	B4	IDR 72,895,221	IDR 80,531,086	IDR 137,271,394	IDR 122,165,104
	B5	Rp. 8,372	Rp. 239,336	IDR 247,709	IDR 247,709
	Sub-Total	IDR 72,903,593	IDR 80,770,423	IDR 137,519,103	IDR 122,412,813
Net Benefits		**IDR 159,039,098**	**IDR 11,293,280,522**	**IDR 965,892,159**	**IDR 1,030,207,915**
Net Value		**-Rp 29,118,371**	**IDR 9,657,293,149**	**-Rp 480,866,953**	**IDR 235,498,801**
BCR		**0.85**	**6.90**	**0.67**	**1.30**

(Source : Analysis Results)

3.3. Condition Analysis Existing Subdistrict Malalayang

On analysis existing conditions in the District Malalayang obtained mark *Net Value* amounting to -Rp. 29,118,371.08 and for BCR of "0.85" or BCR < 1, caused by value High *net* cost in comparison *Net Benefit* , so existing conditions must be improved to make it feasible operate .

3.4. Scenario First Development of District 3R TPS Malalayang

In scenario analysis _ First capacity production from machine enumerator rubbish optimized and additions one machine unit enumerator plastic , the addition of two sieving units compost is optimized in accordance amount capacity machine /hour, and do addition the area of the room reception trash , warehouse compost , and development warehouse plastic For cost addition area land development first District 3R TPS Malalayang Rp. 10,301,745.00 , from results optimization from machines and additions area size increases results production compost and seeds pet plastic (B1) with turnover annually is amounting to Rp. 10,862,256,999 and efficiency material burn vehicle carrier rubbish from subdistrict malalayang and sario (B2) amounting to Rp. 338,125,200 later subtraction emission from vehicle CO2 carrier waste in the district Malalayang amounting to 52.11 tons/ year and sub-district sario 17.31 Tons/ Year (B3), converted rupiah with a nominal value of Rp. 12,127,899/ Year , then subtraction CH4 emissions in landfills from rubbish in the district malalayang and sario amounting to 460.98 Tons/ Year (B4) converted to rupiah Rp. 80,531,086.64, from results analysis on development First obtained mark *Net Value* Rp. 9,657, 293,149 with mark *Benefit Cost Ratio* of "6.90" so BCR value > 1, so For development This worthy to operate . _

3.5. Second Scenario Development of New District 3R TPS Establishment and Operation of TPS 3R Conditions Existing Subdistrict Malalayang

A nalysis of this done development that is development new TPS 3R in the District Mapanget along assets and operations of TPS 3R Kec Malalayang existing condition of its operation to two TPS 3R in two sub-districts can produce mark *Net Value* -Rp 480,866,953 with mark *Benefit Cost Ratio* "0.67" or BCR < 1, caused mark More *Net* Cost tall compared to mark *Net Benefit* , because big cost investment land and tools cause mark *Benefits* No comparable with The resulting *costs* , so development This No worthy to operate .

3.6. *Third Scenario _ Development of TPS 3R in Paal Dua Subdistrict which is not operational and TPS 3R Operational Conditions Existing Subdistrict Malalayang*

On analysis This namely the development process with method normalization of TPS 3R Paal Dua District and operational conditions of TPS 3R Existing Subdistrict Malalayang , at TPS 3R Paal Dua District , this was carried out addition machines and vehicles with did it addition machines and vehicles operational capacity processed waste become standard namely 1000 kg/ day, from its operation to the two TPS 3R on the second subdistrict produce mark *Net Value* Rp. 235,498,801 with mark *Benefit Cost Ratio* "1.30" or BCR > 1. for development This worthy so that can be implemented.

3.7. Regional Minimum Wage Sensitivity Analysis

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sensitivity analysis of Regional Minimum Wages was carried out with method change variable UMR decreased by 20%, UMR decreased by 10%, UMR increased by 10% and UMR increased by 20% in Table 7, which was carried out in the development First , development second and development to three is in Figure 3, so For know is with change UMR variable will be influence taking decision election development other from change BCR value .

Table 7. Regional Minimum Wage Variables

Minimum Wage Drops 20%	Minimum Wage Drops 10%	Standard UMR	Minimum Wage Increases 10%	Minimum Wage Increases 20%
IDR 2,788,000.00	Rp. 3,136,500.00	IDR 3,485,000.00	IDR 3,833,500.00	IDR 4,182,000.00

(Source : Analysis Results)

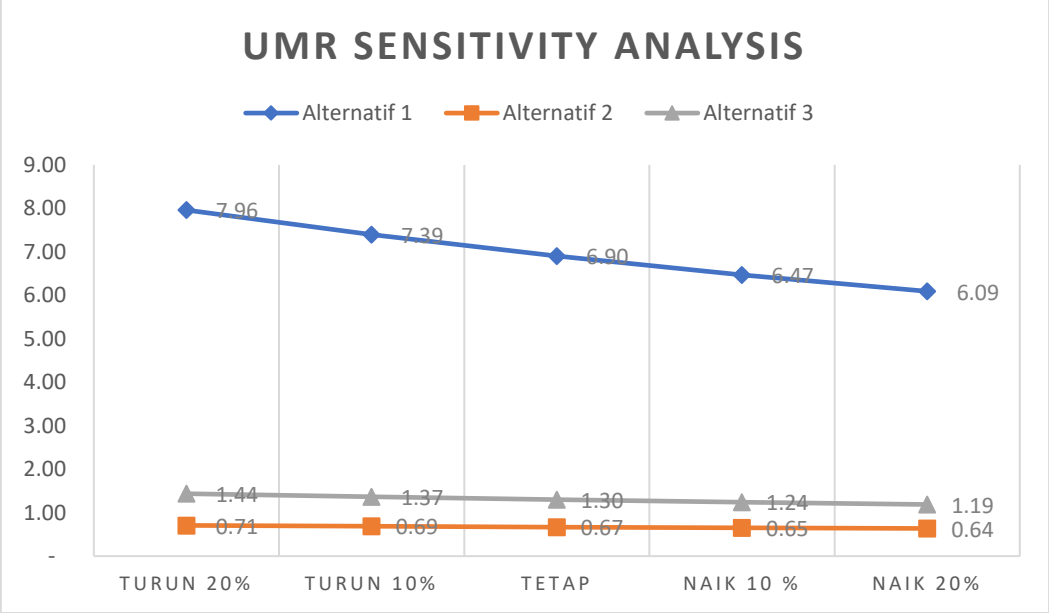

Figure 3. UMR Sensitivity Analysis Graph

From figure 3 you can see conclude with change the UMR variable does not effect on the sensitivity test Because No there are intersecting lines so that alternative First still the best development to choose . _

3.8. Fuel Oil Sensitivity Analysis

Variable analysis of fuel oil done with method change variable fuel down 20%, fuel down 10%, fuel up 10% and fuel up 20% in Table 8, which was carried out in development First , development second and development to three is in Figure 4, so For know is with change fuel variable will be influence taking decision election development other from change BCR value .

Table 8. Fuel Oil Variables

Fuel type	Fuel Drops 20%	Fuel Drops 10%	Fixed fuel	Fuel Increase 10%	Fuel Increased 20%
Pertalite	Rp. 8,000.00	Rp. 9,000.00	IDR 10,000.00	Rp. 11,000.00	Rp. 12,000.00
Dexlite	Rp. 14,920.00	Rp. 16,785.00	Rp. 18,650.00	Rp. 20,515.00	Rp. 22,380.00

(Source : Analysis Results)

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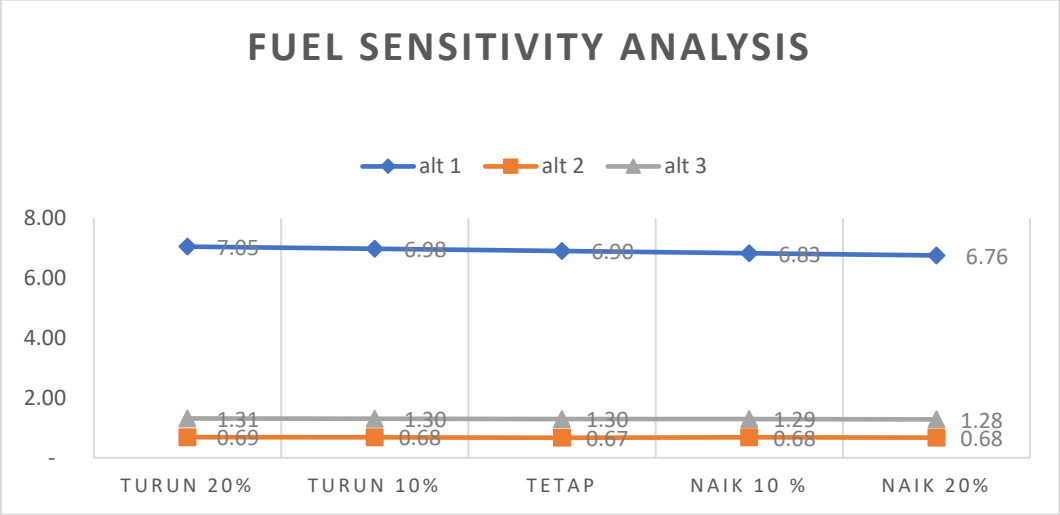

Figure 4. Fuel Sensitivity Analysis Graph

From Figure 4 you can conclude with no changes to the fuel variable effect on the sensitivity test Because No there are intersecting lines between to three development , so alternative First still the best development to choose . _

4. Conclusion

In the process of reducing emergence rubbish so obtained results from three development at TPS 3R, at development First reduced waste _ from TPS 3R District Malalayang amounting to 2,479,792.58 kg/ year with composition rubbish organic 1,225,715.30 kg/ year , and plastic 1,254,077.28 kg/ year , in development to the two reduced wastes from TPS 3R District Mapanget amounting to 237,268.80 kg/ year with composition rubbish organic 176,232 kg/ year and plastic 61,036.80 kg/ year , at TPS 3R District Malalayang condition existing amounting to 8,299.68 kg/ year with composition rubbish organic 4,149.84 kg/ year and plastic 4,149.84 kg/ year , for a total amount waste that is reduced during development secondly 245,568.48 kg/ year , and for development to three amount reduced waste _ The same with development the second amounted to 245,568.48 kg/ year .

Development First own mark *Net Value* Rp. 9,657,293,149 with BCR value of 6.90 or BCR > 1, continue with development the two have mark *Net Value* -Rp 480,866,953 and BCR 0.67 or BCR < 1 and development to three own mark *Net Value* Rp. 235,498,801 and BCR 1.30 or BCR >. After done testing with method *Cost Benefit Analysis* with analysis *Net Value, Benefit Cost Ratio* and analysis sensitivity to three variable development , then most feasible development is development First with mark *Net Value* Rp. 9,657,293,149 and a BCR value of 6.90 or BCR > 1

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